

What do you need to know about WDM?

Everything you need to know to start utilizing DWDM/CWDM on your fiber network.



Who Are we?

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- 35 years of Industry Experience
 - 25 in Carrier Services
 - 10 Consulting/VAR
- Based in DFW Texas-America
- Specialize in Helping Tier II & III Service Providers/WISPs Architect/Design/Implement Next Generation Network Infrastructure: Transport-Core-Peering Edge and Security.
- Uniquely Designed Solutions specific to our Customers' Needs and Requirements.

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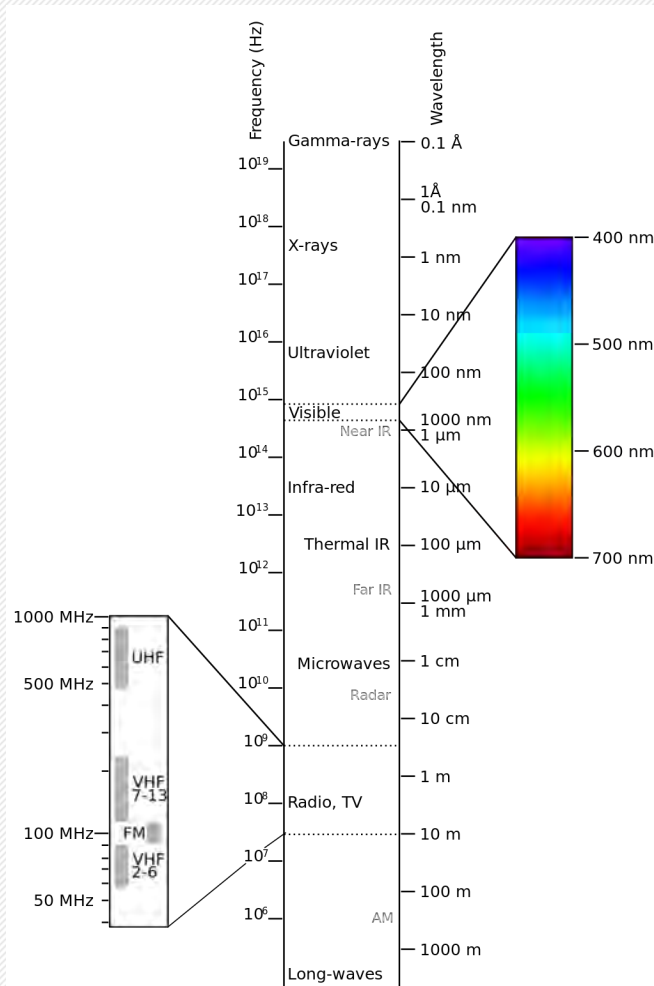
<https://onetapconnect.com/edgeteam-matthamlin/matthamlin>

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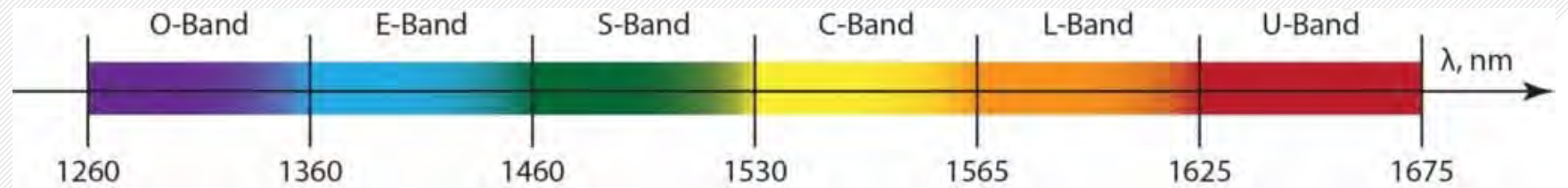
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Where are we in the electromagnetic spectrum?



All of the frequencies we are working with are just below the human visible spectrum, many animals can see 850 nm!



By Original: Penubag Vector: Victor Blacus - Own work based on: Electromagnetic-Spectrum.png, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=22428451>



Optical Communications Band(s)

There are 5 bands that optical communications tend to operate in

850 (normally used for Multi-Mode Fiber)

Original/"O" (1260 – 1360 nm)

Extended/ "E" (1360 – 1460 nm)

Short/S (1460 – 1530 nm)

Conventional/C (1530 – 1565 nm)

Long/L (1565 – 1625 nm)

Most of our WDM options are in the C band, but others are becoming more popular/are in development



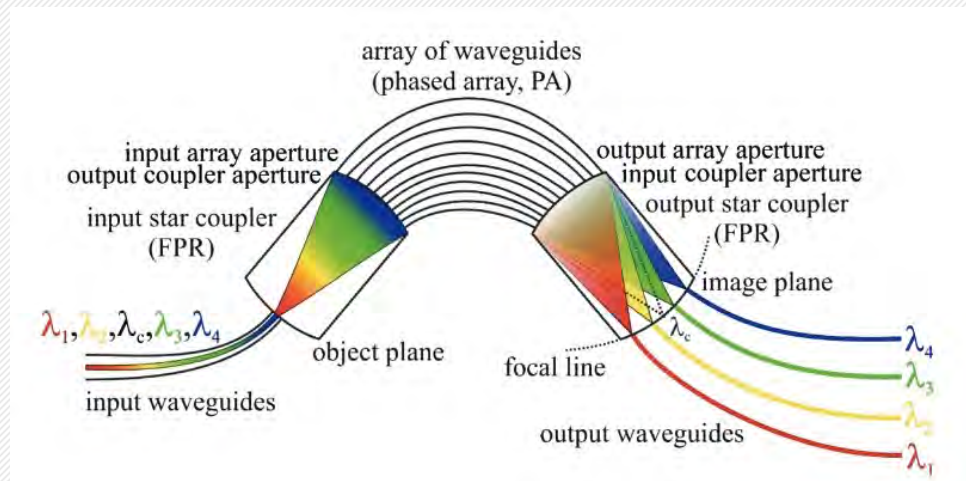
Wavelength Division Multiplexing

- First rule about fiber, every vendor has their own lingo and there's minimal standardization.
- Plain ol' Fiber optics traditionally use a single wavelength for TX/RX. (850, 1300 and 1550)
- Well it's all light in the end, and there's a million different colors.
- You can take one, or normally two, strands of fiber and run multiple distinct services across them.



Why not just use different colors?

- Using a couple prisms and “wave guides”
- “Arrayed Waveguide Gratings”
- Wola! A completely passive Multiplexing/De-Multiplexing system
- Note, not the only way to skin the cat



So, what can we do?

- WDM
 - (Mostly) Just using 1300 and 1550 together
 - BiDi optics, any of the xPON
- CWDM
 - Upto 18 Wavelengths/Channels
 - ~80 km (~50 Freedom Miles)
 - Less susceptible to temperature
 - Uses O through L band
 - Lower cost
- DWDM
 - +160 channels (Note: 100GHz vs 50 GHz)
 - Mostly in the C-Band, expanding
 - +??? Gbps per Channel (it seems to always be increasing)
 - Can be amplified for 100s of km



What to watch out for

- Older fiber (B-652.A/B)
- Mechanical Splices
- Zero Dispersion Shifting (1300 vs 1500)
- Lossy splices



East/West?

We can add or remove individual channels as well

Optical Add/Drop Multiplexers

“East or West” vs “East and West”

Less loss and can fit in a splice tray



Electronics in WDM

EDFA

- Erbium-Doped Fiber Amplifiers

OEO

- Optical, Electronic, Optical

ROADM

- Reconfigurable optical add-drop multiplexer

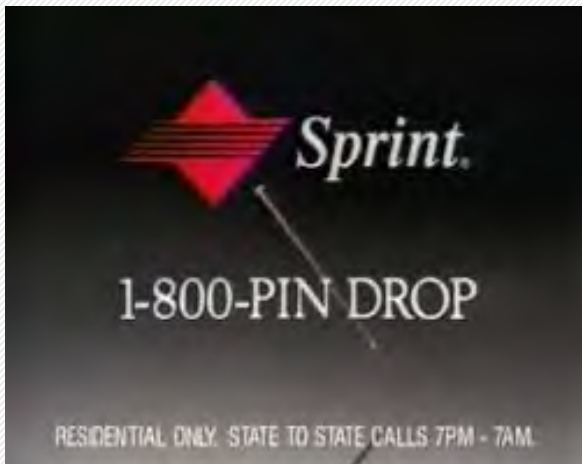
Muxponder

- Think of an 11 port switch
 - 10 1G ports
 - 1 10G port
 - Add in some “VLAN tagging” and that’s it



DWDM – Dense Wave Division Multiplexing

- WDM – first systems used in Labs in 1980 and was only 2 channel
- DWDM 1st deployed by Sprint in June 1996, and then made popular by Qwest in late late 90s early 2000s



DWDM – Dense Wave Division Multiplexing

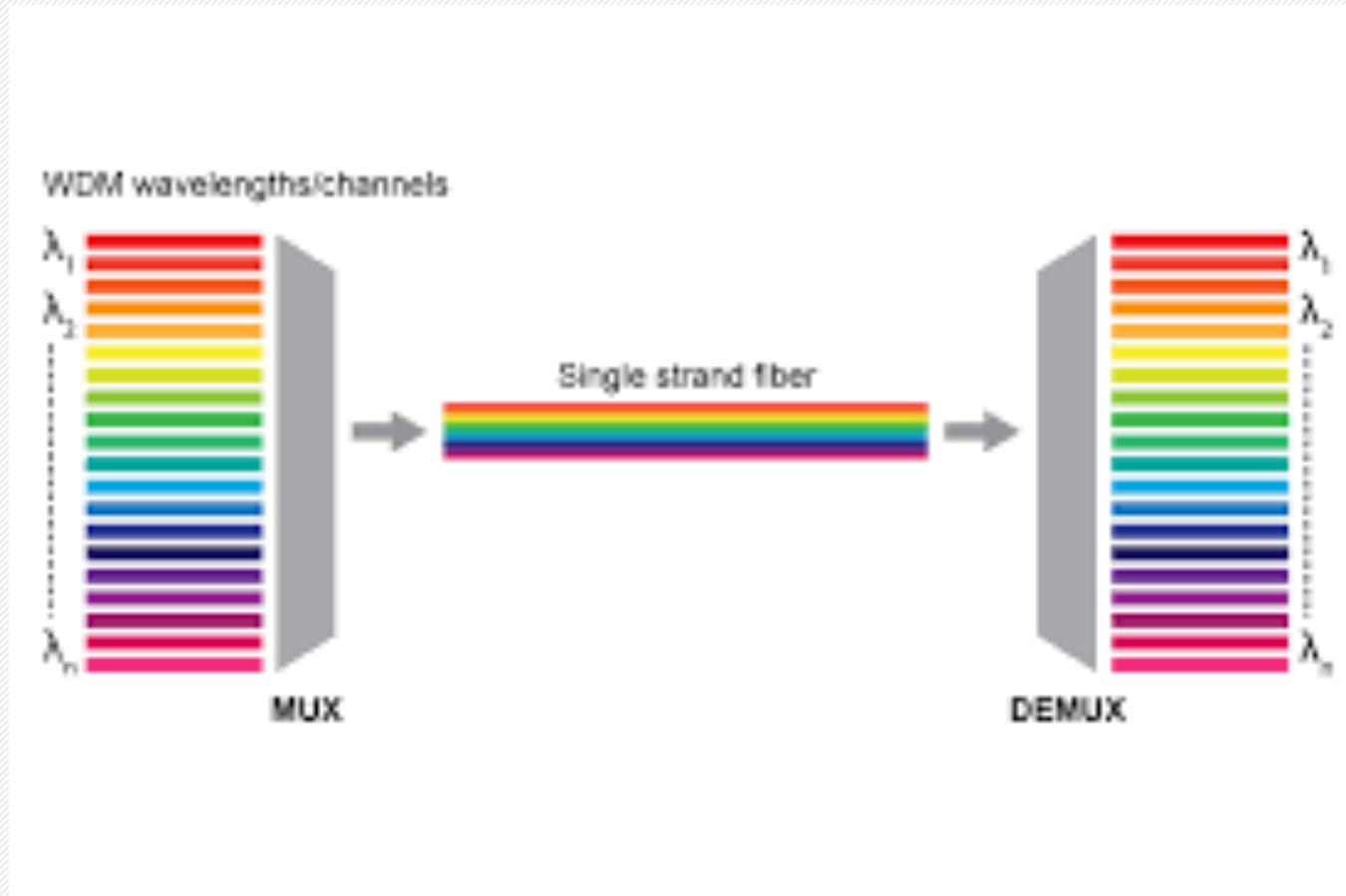
What is it:

A Technology which multiplexes a number of optical carrier signals onto a single fiber by using different wavelengths (colors) of laser light.

Most commonly deployed using Filters/MUX-DEMUX capable of grouping 8, 16, 40, or 96 Channels Per Fiber Pair at speeds of 10G, 100G, 400G, with 800G now rolling out.



DWDM – Dense Wave Division Multiplexing



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Most Common Deployments

ROADM – Reconfigurable optical add-drop multiplexer
Network operators can remotely reconfigure the Multiplexers
Common deployments, Long Haul Transport and Middle Mile Transport

IPoDWDM – Integrated IP routers and network switches in the Optical Transport Network. Also known as IP Optical Switching.

Common deployments, Middle Mile, Metro Ethernet, Front Haul.

The most versatile, combining a number of DWDM ports and Aggregation switching into the same box. Very cost effective in today's market.



DWDM – Dense Wave Division Multiplexing

Advantages

- Super Capacity
- Investment Protection
- Wave Routing
- Reconfigurable
- Cost-Effective
- Scalability
- Transparency Low-Latency
- 5G Ecosystem
- Longer Spans

Drawbacks

- Higher cost for fewer channels
- System Complexity
- Frequency domain – increased difficulty of implementation
- Wide-band change



DWDM – Manufactures



THANK YOU



Great resources:

- [Fs.com/blog](https://fs.com/blog) – they may be cheap, but they have good beginner info that's a decent starting point for many fiber topics
- thefoa.org – an industry resource that is my first place to go when diving deeper into topics. These guys do a lot for the community.
- Vendor resources, vendors need you to believe they are professionals. If you have a question, ask your rep and see if they have the internal resources to answer it for you.



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